IS 401 (2001): Preservation of Timber - Code of Practice
[CED 9: Timber and Timber Stores]

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IS 401 : 2001
(Reaffirmed 2002)

भारतीय मानक

टिम्बर के संग्रहण की रीति संहिता

(चौथा पुनरीक्षण)

Indian Standard

PRESERVATION OF TIMBER — CODE OF PRACTICE

(Fourth Revision)

ICS 79.020

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2001

Price Group 9

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Timber and Timber Stores Sectional Committee had been approved by the Civil Engineering Division Council.

This standard was first published as a tentative standard in 1954 and was subsequently revised and issued as a firm standard in 1961. With the use of this code over a period of 6 years, the Sectional Committee felt that it might be revised so as to make it up-to-date and also to include some more information on prophylactic treatment, diffusion process, etc. Second revision of the standard was, therefore, brought out in 1967 and the third revision in 1982. In the third revision, besides modifying durability and treatability figures for some of the species, modifications were made in Table 2 giving recommended practices for preservation of timber for different service conditions. In this revision, treatment process for treating rubber wood, khasi pine, poplar, etc in green condition has been included besides modifying durability and treatability figures for some of the species and inclusion of some new species in Table 3 and further modifications have been made in Table 2. Since the subject of preservation and treatment of railway sleepers has been covered under a separate standard, reference to railway sleepers has been omitted from this standard. However, it deals with track wooden sleepers for other uses.

With the rapid industrial and agricultural development of the country, the demand for timber for various purposes has increased considerably and in view of the limited availability of naturally durable species, such as teak (*Tectona grandis*) and sal (*Shorea robusta*), it is imperative that supplies of durable timber are augmented by selected timbers of lesser durability which, when suitably treated, would give adequate life under service conditions. Preservative treatment of timber, therefore, forms a very important part of the national effort to conserve the material resources of the country, and to achieve their most economic utilization.

The timber availability scenario is changing fast in the country. While the supply of timber from traditional species from the forest is decreasing, timber from plantation species such as rubber, eucalypts, poplar, etc, is becoming increasingly available. Such species are normally non-durable and their economic utilization requires adequate protection, when used in hazardous situations (where biological attack is likely to be more prevalent) for longer life. Timber with more sapwood content (easily treatable) or timber having good treatability (a, b or c) shall be preferred.

The efficacy of preservative treatment depends on the proper choice of preservative and the treatment process, which ensure the required absorption and penetration of the preservative.

A number of preservatives and processes of treatment are known which give varying degrees of protection to wood against deterioration due to attack by fungi, termites, borers and marine organisms.

This standard is intended to serve as a guide in the choice of the preservatives and their methods of application. Preservative treatment of timber, however, is not carried out with the purpose of improving density or hardness or mechanical/electrical/chemical properties. Preservative treatment and seasoning make the wood stable and durable. However, such preservative treated and seasoned wood is distinct from densified wood of the same species and should not be classified as densified wood.

Timber to be treated should, wherever possible, be fully fabricated before treatment and all cutting and boring operations on the treated material should be avoided. In case it becomes absolutely necessary to cut or bore a treated member, the surface exposed should be thoroughly brushed with organic solvent based preservative. Care shall be taken in handling the treated timber, so that damage to the treated shell does not expose the untreated portion, if any.

Most of the preservatives are poisonous or skin irritant and some are inflammable or explosive or yield poisonous vapour when treated material catches fire and therefore both workers in the field and factories and actual users of treated material should be careful in proper handling of preservatives, treating solutions as well as freshly treated wood. They should have knowledge to take first-aid measures.

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Indian Standard

PRESERVATION OF TIMBER — CODE OF PRACTICE

(Fourth Revision)

1 SCOPE

1.1 This standard covers types of preservatives, their brief description, methods of treatment, choice of treatment for different species of timber for a number of uses and determination of degree of penetration. Prophylactic treatment of logs and sawn timber during storage is also covered.

1.2 This standard includes only such preservatives and methods of treatment which have given satisfactory results under the Indian conditions of service.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TYPES OF PRESERVATIVES

Preservatives shall be of the following three types.

3.1 Type 1 — Oil Type

Coal/Lignite tar creosote with or without admixture of coal tar petroleum oil, fuel oil or other suitable oil having a high boiling range.

3.2 Type 2 — Organic Solvent Type

Copper and zinc naphthenates, copper and zinc abietates, trichlorophenol, gamma- BHC (Lindane), chlorpyrifos and synthetic pyrethroids.

3.3 Type 3 — Water-Soluble Type

3.3.1 *Water-Soluble (Leachable) Type*

Zinc chloride, boric acid, borax, sodium pentachlorophenate, gamma-benzene hexachloride (water dispersible powder), sodium fluoride, chlorpyrifos and synthetic pyrethroids.

3.3.2 *Water-Soluble (Fixed) Type*

Copper-chrome-arsenic composition, acid-cupric-chromate composition, copper-chrome boron composition, zinc meta-arsenite, borated copper-chrome-arsenic composition and ammoniacal copper-arsenate composition.

4 DESCRIPTION OF VARIOUS PRESERVATIVES AND THEIR PROPERTIES

4.1 Oil Type

Coal/Lignite Tar Creosote (CTC/LTC) is a fraction of coal tar distillate with a boiling point range above 200°C and is especially suitable for treatment of timber, products, etc, for exterior use. It may be used alone or with a suitable admixture as mentioned in **3.1**. While petroleum fuel oil as such has practically no toxic properties, its presence in the mixture to the extent of 50 percent by weight ensures stability to creosote against evaporation and leaching from the treated material. In addition, admixture of oil gives a certain amount of protection to it against splitting and cracking. In place of fuel oil, coal tar is recommended for admixture with creosote for treatment of marine timber.

4.1.1 The advantages of using creosote as a preservative are that it has high toxicity and relatively high permanence and is non-corrosive. It offers good protection against termites. Creosote is, however, not clean to handle, has an unpleasant odour, and the material treated with it is difficult to be painted.

4.1.2 Creosote used for preservation under Indian conditions shall conform to IS 218. Any grade of fuel oil generally conforming to IS 1593 may be used with creosote. However, if treatment is to be done by a hot and cold process and if HV grade fuel oil is used, an appropriate diluent may be added to bring down the viscosity to the level of LV grade.

4.2 Organic Solvent Type

These preservatives are dissolved in suitable organic solvents and may be used separately or in combination. The choice of the solvent depends on the solubility of the preservative and the use to which the treated material is put to. These preservatives are permanent and the treated material is clean to handle when light organic solvents are used.

4.2.1 In most cases treated material can be painted, waxed or polished. As some of the solvents are inflammable, care is necessary in handling the solutions, and in such cases, the preservative shall be applied cold.

4.2.2 *Copper and Zinc Naphthenates/Abietates*

These are copper and zinc salts of naphthenic acid (*see* IS 1078) and abietic acid.

4.2.3 *Trichlorophenol (TCP)*

It is a chlorinated derivative of phenol.

4.2.4 *Gamma - Benzene Hexachloride*

It is gamma isomer of a fully additive chloro-compound of benzene known as gamma-BHC (*see* IS 882).

4.2.5 *Chlorpyrifos*

It is suitable for use in prophylactic treatment against borers (*see* IS 8944).

4.2.6 *Synthetic Pyrethroids*

Synthetic pyrethroids such as cypermethrin (*see* IS 12016) and deltamethrin (*see* IS 11996) are suitable for use in prophylactic treatment against borers.

4.3 Water-soluble (Leachable) Type

These preservatives are inorganic or organic salts soluble in water. These preservatives are, however, subject to leaching, that is, the amount of preservative in the treated material gets gradually depleted owing to the dissolving effect of water. This leaching of the preservative can be, to some extent, reduced if a waterproof paint coating is applied on the treated material and is maintained properly.

4.3.1 These are generally odourless, and involve little fire hazard. Material treated with these preservatives can be painted or varnished or waxed, when dry.

4.3.2 *Boric Acid and Borax*

These have been used successfully against Lyctus borers, sapstain and some species of termites and are especially suitable for protecting veneers, plywood and packing case timbers for tea chests and for packing edible articles. They are also used as glue line protectants.

4.3.3 *Sodium Fluoride*

It is a good fungicide and is used for protecting glue line.

4.3.4 *Sodium Pentachlorophenate (Na-PCP)*

It is effective against fungi causing mould and sapstain.

4.3.5 *Gamma-BHC (Water - Dispersible Powder)*

It is suitable for use in spray or brush treatment as prophylactic against borers (*see* IS 882).

4.3.6 *Chlorpyrifos*

It is suitable for use in prophylactic treatment against borers (*see* IS 8944).

4.3.7 *Synthetic Pyrethroids*

Synthetic pyrethroids such as cypermethrin (*see* IS 12016) and deltamethrin (*see* IS 11996) are suitable for use in prophylactic treatment against borers.

4.4 Water-soluble (Fixed) Type

These preservatives consist of mixture or various salts having broad-spectrum efficacy against a variety of organisms and a fixative salt, usually sodium or potassium dichromate. The role of chromium is to fix the toxic element, arsenic, copper, boron, etc, in the timber, so that the toxic salts become difficult to leach by the action of water. It is, however, necessary that the treated material be allowed to dry for 2 to 3 weeks to complete the fixation process. These preservatives shall be applied cold, as these are liable to get precipitated when heated, particularly in the presence of reducing substance in timber.

4.4.1 Timber treated with these preservatives may be used outdoors and can also be painted.

4.4.2 *Copper-Chrome-Arsenic Composition (CCA)*

The preservative shall conform to IS 10013 (Part 2). The preservative is especially recommended in heavy termite and marine borer infested areas and in cooling tower timbers where soft rot is the chief deteriorating factor.

4.4.3 *Acid Cupric-Chromate Composition (ACC)*

The preservative shall conform to IS 10013 (Part 1). It is basically effective against fungi and recommended for interior use (out of ground contact) in areas with no termite hazards.

4.4.4 *Copper-Chrome-Boron Composition (CCB)*

The preservative shall conform to IS 10013 (Part 3). The preservative is recommended for general use, including timber in cooling tower.

4.4.5 *Zinc-Meta-Arsenite*

This preservative comprises arsenic trioxide (As_2O_3) and zinc oxide (ZnO) in the ratio of 3 : 2, and acetic acid just sufficient to keep zinc-meta-arsenite in solution under operating conditions.

4.4.6 *Borated Copper-Chrome-Arsenic Composition (BCCA)*

This preservative is recommended where CCB is used.

4.4.7 *Ammoniacal Copper Arsenite (ACA)*

Recommended for treating refractory wood species like eucalypts. This preservative can be used at elevated temperatures to reduce treating period.

5 PROPHYLACTIC TREATMENT

5.1 Freshly felled timber is liable to be immediately attacked by fungi and insects and may also develop

splits and cracks. These can be avoided or minimized if prompt action is taken.

5.2 Splits and cracks develop because of wide difference in the moisture content in the fresh logs and the relative humidity of the surroundings and this becomes pronounced in the hot and dry season and least in the rainy season. This may be controlled by end coats and also by ponding the logs in fresh water. In the case of logs of decorative species like teak, rosewood, padauk, walnut, etc, Bark shall be removed altogether and an artificial bark of a bituminous composition (*see* IS 1141) containing preservatives created to protect both mechanical and biological damage. This composition is amenable to removal after warming at the processing centres for reuse.

5.3 In the case of logs of non-durable species, while the bark in some cases gives protection against damage by insects and fungi, in most cases, attracts and harbours pests and diseases. In such cases, the bark shall be removed and all the surfaces shall be sprayed with preservatives and also end coats applied. This shall be done at the felling site, if the logs are not removed quickly to storage yards.

5.4 In case the logs require to be stored for long periods, these shall be ponded in fresh water, if such facilities exist, or these shall be properly stacked high above the ground and continuously sprayed with water preferably containing insecticides and fungicides. To economize the process the drips shall be collected in a suitable reservoir for recirculation. If the log ponds are connected with sea water or back waters or sewage waters where marine borers and bacterial damage are a threat, the logs after debarking shall be well painted on all surfaces with a concentrated solution of the preservative and further protected by end paints, both being not soluble in water or easily washed away.

5.5 The above procedures become ineffective and uneconomical if the damage (mechanical and biological) has already taken place due to delay and negligence. If however, the insect/fungal attack is superficial and light, the only method to arrest the same is to sterilize the logs by boiling in hot water or steaming. Thereafter, the prophylactic treatments shall be undertaken to prevent fresh infection. Mechanical damage, particularly in the case of track sleeper, can be controlled by metal straps and end 'S' holds (*see* IS 10753). These shall also be used in the case of costly logs.

5.6 Periodic inspection of stacks shall be carried out and, if necessary, the treatment shall be repeated.

6 PREPARATION OF MATERIAL FOR TREATMENT

6.1 Whatever the method of treatment adopted, material for treatment shall be sound. Except in the case of treatment by diffusion, Boucherie or alternating pressure method (APM), material shall be dried to appropriate moisture content. Any wood working to be done, including cutting to size, boring, etc, shall be completed prior to treatment. Approximate permissible moisture content prior to treatment of material is given in Table 1.

6.1.1 While treating thicker sections of timber in which heartwood is non-durable and refractory to treatment, all the surfaces, other than the ends should be incized to a depth of 12 to 20 mm for proper penetration of preservative.

6.1.2 The material shall be air-seasoned to fibre saturation point (*see* IS 1141).

6.2 The green timber which is easily liable to decay by fungi during the course of air-seasoning in warm and humid climates shall be subjected to steaming. The treatment consists of steaming the timber at 1.5 kg/cm^2 pressure for a period depending on the size and moisture content of the material and then subjecting it to vacuum. The cycle of steaming and vacuum is repeated till the moisture content of the material reaches the required limit. The charge shall then be subjected to any one of the types of preservative treatments described in 7.

6.3 Where a further reduction in the moisture content is desired before preservative treatment, as in the case of certain species of timbers used for sleepers, poles, these may be dried (conditioned) by the Boulton process (*see* **7.6**).

6.3.1 This consists of heating the timber under vacuum applied gradually in the presence of a suitable high boiling liquid. This could preferably be the preservative itself; for example, creosote-fuel oil mixture may be used if the timber is to be ultimately creosoted. In such a case, pressure process (*see* **7.5**) is recommended for preservative treatment.

6.4 Treatment with water soluble type preservatives is possible even at high moisture content by alternating pressure method.

7 METHODS OF TREATMENT

7.1 Surface Application

This is done by brushing, spraying or dipping in the preservative solution for a short period. For this treatment, timber (if it is round) is debarked thoroughly. For the oil type of preservatives, the moisture content in the material shall not be more than 20 percent. With aqueous solutions, moisture content of 20 to 30 percent is permissible. At least two coats should be applied, the second and subsequent coats are to be applied after the first has dried or soaked

Table 1 Permissible Moisture Content at the Time of Treatment of Timber

(*Clause* 6.1)

Sl No.	Timber	Process	Approx Moisture Content, Percent
(1)	(2)	(3)	(4)
i)	Poles, fence posts and timber belonging to treatability grades (a) and (b) (*see* **B-3**)	Open tank hot and cold process	15-20
ii)	All other classes of timber whether included in (i) above or otherwise	Pressure treatment	Less than 25 [below fibre saturation point[1)]]
iii)	Poles, fence posts (with branch/bark intact)	Boucherie treatment	Green, freshly felled
iv)	Round or sawn	APM	Green, freshly felled, more than 60

NOTE — The moisture content specified shall be that of the outer layer of the sleepers/poles to a depth of about 20 mm and may be estimated by a suitable moisture meter or by means of conventional oven drying method. In the case of sawn timber of lower dimensions, the moisture content shall be an average of the entire cross-section.

[1)] A very rough estimate of this point may be made by taking a boring with an increment borer and scoring its surface with a copying pencil. The free moisture above fibre saturation point is indicated by the deeper colour, thereby giving an approximate idea of the extent and depth to which the relative drying has occurred.

into the wood. Where practicable, the treatment is done hot. Surface treatment has a limited scope, and is used mostly for treating material at site and for re-treatment of cut surfaces. This may be repeated periodically.

7.2 Soaking Treatment

In this, the material is debarked thoroughly (in the case of round timber), and the treatment is carried out by submerging it in the preservative solution for a sufficiently long period until the required absorption of the preservative is obtained.

Normally, soaking of veneers in the preservative solution for a period of 1 to 2 min is adequate for thickness up to 1.8 mm in the case of refractory species and up to 3 mm for other species. Prefinished joinery/furniture components/items can also be treated with light organic solvent type wood preservatives by this process.

7.3 Hot and Cold Process

The timber is submerged in the preservative oil or solution, which is then heated to about 90°C and maintained at this temperature for a suitable period, depending on the charge. It is then allowed to cool until the required absorption of preservative is obtained. During the heating period, the air in the timber expands and part of the moisture is converted into vapour and is expelled; during cooling, the residual vapour/air in the timber contracts, creating a partial vacuum, which causes the preservative to be sucked into the timber.

7.3.1 This treatment also ensures sterilization of the material against fungi and insects that may be present. In the absence of facilities for pressure treatment (*see* **7.5**), this process is recommended for material containing sapwood, easily treatable heartwood, etc. With water soluble (fixed) type preservatives, however, there is a possibility of the chemicals precipitating at higher temperatures and in contact with the extractives in timber. To overcome this difficulty, two baths are used, the first containing water where the hot treatment is given, and the second, the cold bath, containing the preservative into which the material is transferred immediately after heating.

7.4 Boucherie Process

Treatment of sapwood of almost all green round timbers, soon after felling with the bark on may be carried out using any of the inorganic water soluble preservatives. The treatment is carried out by attaching to the butt-end of a pole, a rubber hose connected to a reservoir containing the water borne preservative solution and placed at a sufficiently higher level. The pole is held in an inclined position, generally at an angle of 45° to the horizontal. Due to hydrostatic pressure, the preservative displaces the sap which is then forced out at the narrow end. The treatment is stopped when the concentration of preservative in the drip is nearly the same as that of the solution in the reservoir. If an air pressure of 1 to 2 kg/cm^2 is applied on the surface of the preservative in the reservoir, the reservoir, need not be raised high above the ground and the treatment can be hastened to an appreciable extent. Pressure up to 5 kg/cm^2 may be used for treatment of green poles with specially designed pressure caps.

7.5 Pressure Process

Pressure process may be employed with any type of preservative. In the case of oil type preservative, a

temperature of 80 to 90°C shall be maintained during the pressure period.

7.5.1 *Full Cell or Bethel Process*

This process is used when maximum absorption of the preservative is desired, that is, filling up the cells and saturating cell walls with the preservative. The charge is introduced into the cylinder. In the case of thin planks and plywood, spacers or grills should be used to separate the pieces. The door is tightly closed and then a vacuum of at least 56 cm of mercury is created and maintained for half an hour. The object of this operation is to remove as much air as possible from the cells. At the end of the vacuum period, the preservative is introduced into the cylinder, with the vacuum pump working. When the cylinder is filled with the preservative, vacuum pump is stopped and the cylinder is subjected to an antiseptic pressure of 3.5 to 12.5 kg/cm^2, depending on the species, size, refractory nature of the material, etc. This injects preservative into the timber. The pressure is held until the desired absorption is obtained, after which the preservative is withdrawn from the cylinder and finally a vacuum of 38 to 56 cm of mercury for about 15 min is once again applied to free the material from the dripping preservative. Specified retention of toxic chemicals during treatment may be obtained by a proper selection of the concentration in the treatment solution and the duration of pressure and vacuum periods. This method is recommended to treat refractory material or material needing high preservative retention.

7.5.2 *Empty Cell Processes*

These processes aim at a maximum penetration of the preservative with minimum net absorption. Two processes, namely Lowry process and Rueping process are given under **7.5.2.1** and **7.5.2.2**.

7.5.2.1 *Lowry process*

The cylinder is loaded with the material and then closed. It is then filled with the preservative; an antiseptic pressure of 3.5 to 12.5 kg/cm^2, depending on timber species, size, etc, is applied until slightly higher than the required absorption is obtained. When the pressure is released, certain amount of the preservative is expelled due to the expansion of the entrapped air in the cells. The cylinder is then drained off, applying a final vacuum as described in **7.5.1**. This is especially recommended for thatch, ropes, etc and for a and b treatability class timbers.

7.5.2.2 *Rueping process*

In this process an initial air pressure of 2.0 to 5.0 kg/cm^2 is applied for a specified period, depending on the sapwood content and is maintained during the subsequent stage of filling up the cylinder with the preservative. When the cylinder is filled, an antiseptic pressure of 3.5 to 12.5 kg/cm^2, depending on species, size, etc is applied until sufficient absorption is obtained. This is followed by vacuum, as described in **7.5.1**. In this case, the preservative expelled on the release of the antiseptic pressure is considerable and also there is a low net absorption. This process is especially recommended for treating timber of mixed species and also timber containing sapwood and treatable heartwood.

7.5.3 *Fast Fluctuating Pressure Process (FFP)/ Alternating Pressure Method (APM)*

In this process, even the freshly cut green material can be treated with water soluble wood preservatives. An initial vacuum of approximately 56 cm of mercury is created and maintained for 3 min and the preservative solution is introduced. Usually a higher strength solution, 6 to 10 percent, is required, as the water present in the wood tends to dilute the concentration.

In the APM, a pressure ranging between 7.0 and 12.5 kg/cm^2 is created and maintained for 10-15 minutes and abruptly dropped to zero. The pressure is again raised and maintained for 8-10 min and dropped. Several cycles of raising and dropping pressure are carried out and holding pressure time is decreased in subsequent cycles.

In FFP method, a pressure of 12.5 kg/cm^2 is created and immediately released. Several pressure cycles are repeated depending on the thickness of the material and moisture content. The FFP is quicker than APM and leads to better distribution of preservatives throughout the thickness. Finally the preservative solution is withdrawn and a final vacuum for about 30 min is given to free the material from dripping. Complete penetration with adequate loading of preservative is obtained easily in easy-to-treat species like rubber wood, khasi pine, poplar, etc. Round timbers (fence posts, poles, etc) like eucalypts having adequate ring of sapwood can also be adequately treated by this process. The methods are especially suited to perishable species which are attacked by fungi/insects immediately after felling and during drying if proper prophylactic treatment is not given.

7.6 Boulton Process

It is a combination of conditioning of wet material by boiling and drawing vacuum till the desired moisture is taken off and treating the material subsequently in the same cylinder, generally using creosote-fuel oil mixture (*see* **6.3**).

7.7 Diffusion Process

The diffusion process is a method of treatment of timber (pole and planks) and other plant materials like

bamboos, canes, palm leaves, veneers, etc in green condition. It lends itself best in the case of timbers which are not easy to impregnate under pressure in dry condition, and also, where there is danger of timber getting deteriorated during seasoning, particularly if air-seasoning is adopted. It is carried out as follows:

a) Momentary dipping in concentrated solution and then close stacking under cover. For refractory veneers over 1.6 mm, 15 min soaking and 1 to 2 h stacking is necessary. It is essential that the glue used for subsequent bonding is compatible with the preservative.

b) Prolonged immersion in dilute solution and then close stacking under cover.

c) Application of a paste of the preservative over all the surfaces of the timber and then close stacking under cover. This is especially recommended for treatment of refractory species like fir generally used as sleepers and beams.

d) Injecting the paste into timber through incisions on the surface of timber.

7.7.1 In all these cases, the inorganic toxic ions diffuse into timber from the place of application at high concentration to other zones through the medium of water contained in it. Thus, by giving sufficient time, the toxic ions spread to almost the entire volume of the green timber. Thus depth of penetration and the amount of preservative absorbed in the diffusion process depend on the concentration of the preservative, the diffusion rate of the ions, the period of diffusion, species of timber, its moisture content, atmospheric/preservative temperature, etc.

8 CHOICE OF TREATMENT

The choice of treatment is governed by the timber to be treated, its sapwood content and the use to which it is put to. Treatment is necessary in the case of:

a) Sapwood of all species of timber including durable species, when it is used indoors, outdoors or in wet location,

b) Heartwood of non-durable species, and

c) Heartwood of durable and moderately durable species, if timber members are required to give long life under severe conditions of service.

8.1.1 For marine structures, all materials shall be pressure treated. In the case of refractory species of timber, treatment shall be done to refusal (after incising) using full-cell process.

8.2 The recommended practice with regard to the choice of preservative, treatment process, absorption and penetration of the preservative for various uses, including prophylactic treatment, are given in Table 2.

8.3 Information with regard to durability (*see* **B-2**) and grade of treatability (*see* **B-3**) of different species of timbers is given in Table 3.

9 TESTING

9.1 The purchaser or his agent shall have access to all parts of the plant used in the preparation and treatment of the timber, including records thereof, and shall be free to be present, whenever he desires to see that the treatment is carried out as specified.

9.2 Before the treatment is carried out the moisture content of the materials shall be determined by the method given in Annex C.

9.3 The strength of the preservative solution shall be determined by analysis. An approximate idea can be had with a hydrometer duly calibrated for the preservative solution.

9.4 The net absorption of the preservative in the timber shall be determined by chemical analysis (wherever possible) of the treated timber as selected by the method described in **9.5** and this shall be compared with the figure obtained from service tanks readings or weight of the charge before and after treatment [*see* IS 2753 (Part 1)].

9.4.1 The net absorption of oils shall be expressed as kilograms per cubic metre employing temperature corrections, wherever necessary; in the case of salts, weights of dry chemicals in kilograms including the water of crystallization per cubic meter, shall be given.

9.5 After treatment, the purchaser or his agent shall examine the charge and select material at random to be bored or cut for determining the extent of penetration of the preservative by one of the methods given in Annex D and for chemical analysis for the determination of absorption, as mentioned in **9.4**, sufficient number of samples shall be selected depending upon the volume of the charge so as to obtain reasonably accurate value of the efficiency or treatment.

9.5.1 Boring shall be taken approximately midway between the ends of the pieces selected, avoiding checks, knots, pitch pockets, shakes and splits. An increment borer is recommended for this process. The bored holes should be filled with preservatives and then plugged with tight fitting cylindrical pieces of treated timber.

10 INSPECTION OF PLANT EQUIPMENT

10.1 Plant Equipment

Plant equipment shall be checked frequently to

determine its reliability. Any error which exceeds the limits specified under **10.2** to **10.4** shall be entered in the records till the equipment is restored to normal working order. As far as possible recording instrument shall be used.

10.2 Thermometers

Thermometers shall be checked against standard thermometers certified by the National Physical Laboratory, and a variation up to ±1°C shall be permissible.

10.3 Pressure and Vacuum Gauges

These shall be compared with standard gauges certified by the National Physical Laboratory and a variation up to ± 0.5 kg/cm^2 in pressure and ± 2.5 mm of mercury in vacuum, shall be permissible.

10.4 Track and Track Scales and Balance

Track scales are used for weighing the timber charge before and after treatment for calculating the absorption of the preservative. Tank scales are used to determine the absorption of the preservative per charge by taking the reading of the depth of the preservative in the service tank before and after treatment of charge. Small balances are used for the determination of the moisture content of specimens of timber prior to treatment, bigger ones being used for weighing preservatives and chemicals for making solutions. All the scales and balances shall be checked and a tolerance of ± 2 percent shall be permissible.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
218 : 1983	Specification for creosote and anthracene oil for use as wood preservative (*second revision*)
882 : 1984	Specification for lindane (*first revision*)
1078 : 1987	Specification for copper naphthenate (*second revision*)
1141 : 1993	Seasoning of timber — Code of practice (*second revision*)
1593 : 1982	Specification for fuel oil (*second revision*)
2753 (Part 1) : 1991	Methods for estimation of preservatives in treated timber and in treating solutions: Part 1 Determination of copper, arsenic, chromium, zinc, boron, creosote and fuel oil (*first revision*)
8944 : 1978	Chlorpyrifos emulsifiable concentrates
9104 : 1979	Guide for storage and protection of logs and sawn timber
10013 : 1981	Specification for water soluble type wood preservatives
(Part 1) : 1981	Acid-copper-chrome (ACC) preservative
(Part 2) : 1981	Copper-chrome-arsenic (CCA) wood preservative
(Part 3) : 1981	Copper-chrome-boron (CCB) wood preservative
10753 : 1983	Code of practice for preservation of wooden sleepers for railway track by pressure treatment
11996 : 1987	Deltamethrin, EC
12016 : 1987	Cypermethrin, EC

ANNEX B

(*Clause* 8.3)

DURABILITY AND DEGREE OF TREATABILITY OF DIFFERENT SPECIES OF TIMBER

B-1 GENERAL

B-1.1 Information with regard to durability and grade of treatability of different species of timber given in this annex is based on experiments undertaken at the Forest Research Institute, Dehra Dun.

B-1.2 The classification of durability of timber given in Table 3 is based on the graveyard tests carried out in the open, in which test specimens of size 60 × 5 × 5 cm and/or 30.5 × 3.8 × 3.8 cm of heartwood were buried in the ground to half their lengths. The condition of the specimens is examined at frequent intervals and from these observations their average useful life calculated.

B-1.3 In these tests, the heartwood of different species is exposed to decay by fungi and attack by termites. Generally, six specimens of each species are tested. The actual life of a timber in use, however, depends largely upon the local conditions of soil and climate. The classification given in this standard, therefore, indicates merely a comparative value of the durability of various timbers when used in exposed situations subject to atmospheric action and in contact with the ground.

B-2 CLASSIFICATION OF TIMBER ACCORDING TO DURABILITY

B-2.1 Timbers are classified for durability according to the average life of the test specimens in ground contact as follows:

Class	*Average Life (Months)*
I	120 and over
II	60 and over but less than 120
III	Less than 60

B-3 TREATABILITY

B-3.1 The treatability of the heartwood of different species is indicated in 5 grades [(a) to (e)] in col. 5 of Table 3, each grade being defined as indicated below:

a) Heartwood easily treatable;

b) Heartwood treatable, but complete penetration not always obtained, in case where the least dimensions is more than 6 cm;

c) Heartwood only partially treatable;

d) Heartwood refractory to treatment; and

e) Heartwood very refractory to treatment, penetration of preservative being practically nil even from the ends.

B-3.1.1 These grades are based on experiments, carried out on the pressure and non-pressure treatments of various timbers with creosote fuel oil mixtures and with water-soluble preservatives under conditions of treatment which are normally used for these processes. Grades shall, therefore, be taken to represent approximately the degree of resistance offered by the heartwood of the species to the penetration of preservative solution under 10.5 kg/cm^2 hydraulic pressure. In the case of treatment with creosote-crude oil mixture, the liquid is usually heated to 80 to 90°C, but with aqueous solutions, the treatment is generally carried out in the cold to avoid precipitation of the salts.

ANNEX C

(*Clause* 9.2)

METHOD FOR THE DETERMINATION OF MOISTURE CONTENT

C-1 TEST SAMPLE

C-1.1 Baulks and Scantlings

If the timber is in baulks and scantlings, that is, of cross-sections greater than 5 × 5 cm, a boring taken about 30 cm away from an end and roughly in the middle of any side shall constitute the test sample.

C-1.2 Planks

If the timber is in planks of thickness 2.5 cm or less, a section 2.5 cm long, taken at about 30 cm from an end, shall constitute the test sample.

C-1.3 Green Timber

In the case of a charge of evenly dried or green timber of the same species, about a dozen samples shall be taken for obtaining the average moisture content.

C-2 PROCEDURE

C-2.1 The test sample, immediately after it has been bored or cut from the timber, is placed in a tared weighing bottle; the bottle with the sample in it is weighed and then placed with the stopper removed in an oven set at 103 ± 2°C. After 24 hours of drying, the bottle is taken out, stoppered, and cooled to the atmospheric temperature in a desiccator and weighed.

C-3 CALCULATION

C-3.1 The moisture content, in percent, shall be calculated as follows:

$$\text{Moisture content} = \frac{B - C}{C - A} \times 100$$

where

B = mass of the weighing bottle (including stopper) with sample before drying,

C = mass of the weighting bottle (including stopper) with sample after oven drying, and

A = mass of the weighing bottle (including stopper).

ANNEX D

(*Clause* 9.5)

MEHTOD FOR THE DETERMINATION OF PENETRATION OF PRESERVATIVE

D-1 GENERAL

Methods for the determination of penetration of copper-chrome-arsenic composition, zinc chloride and acid-cupric-chromate composition are given below. 'Definite colour reactions are not given by other common preservatives.

D-2 COPPER-CHROME-ARSENIC COMPOSITION, ACID-CUPRIC-CHROMATE COMPOSITION, BORATED-COPPER-CHROME-ARSENIC COMPOSITION AND AMMONIACAL-COPPER-ARSENITE COMPOSITION

D-2.1 Detection for Copper

D-2.1.1 Dissolve 0.5 g chrome Azurol-S and 5.0 g of sodium acetate in 80 ml water and dilute to 100 ml.

D-2.1.2 Spray the solution over split section or boring with a fine spray on the cut surface of treated wood. A deep blue colour shows the presence of copper.

D-2.2 Detection for Chromium

D-2.2.1 Dissolve 0.5 g diphenyl carbazide in 50 ml *iso*propyl alcohol and 50 ml of distilled water.

D-2.2.2 Spray the solution on the boring or cross section of treated wood. Portions containing chromium will develop a purple colour while unpenetrated portion will remain as such.

D-2.3 Detection for Arsenic

D-2.3.1 *Solution* 1

3.5 g ammonium molybdate dissolved in 90 ml distilled water followed by 9 ml concentrated nitric acid.

D-2.3.2 *Solution* 2

0.7 g benzidine dihydrochloride dissolved in 10 ml concentrated acetic acid and diluted to 100 ml by adding 90 ml distilled water.

D-2.3.3 *Solution* 3

30 g stannous chloride dissolved in 100 ml 1 : 1 hydrochloric acid in distilled water.

D-2.3.4 Solution 1 may be prepared fresh for each day testing. Solution 2 and Solution 3 may be stored in clean glass stoppered brown glass bottles for one week.

D-2.3.5 Apply solution 1 to the boring or cross section ensuring that entire wood surface is saturated. After 2 min, excess solution is shaken off and allowed to dry for about 1 min. Solution 2 is next applied in the same way as Solution 1. After 2 min, the excess solution is shaken off and surface allowed to dry for about 1 min. Solution 3 is last applied by pouring over the cross section or boring beginning at untreated part. The entire wood surface will immediately turn bluish.

D-3 METHOD FOR THE DETECTION OF BORON IN BORAX : BORIC ACID, CCB, BCCA

D-3.1 Solution 1

Extract 10 g turmeric powder with 90 g ethyl alcohol. Decant or filter to obtain clear solution.

D-3.2 Solution 2

20 ml of concentrated hydrochloric acid diluted to 100 ml with ethyl alcohol and then saturated with salicylic acid (about 13 g per 100 ml).

D-3.3 Solution 1 is applied on the dry surface of wood by spraying or with a dropper and the surface is allowed to dry for a few minutes. Solution 2 is then applied in a similar manner to the areas that have been coloured yellow by the application of Solution 1. The colour changes shall be observed carefully. Areas having presence of boron turn red.

D-4 METHOD FOR THE DETECTION OF TCP

D-4.1 A special blend of copper and silver ions is used for the determination of trichlorophenol and its distribution in wood. Reddish coloured copper trichlorophenate is formed where trichlorophenol is present thus indicating the exact location of TCP.

D-4.2 This method is recommended rather than dipping the sample in stain solution.

D-4.3 When freshly prepared solutions are used, the reaction is positive. In old solutions (24 h or older) a faint greenish cast appears even on the surface of untreated wood.

D-4.4 Reagents

Cupric acetate $Cu(CH_3COO).2H_2O$

Silver acetate $CH_3COO\ Ag$

Tergitol XD

Distilled water

*Is*opropyl alcohol (99%)

D-4.5 Stock Blends

I		II	
Cupric acetate	4.0 g	Silver acetate	0.4 g
Tergitol XD	0.5 g	Distilled water	100.0 g
Distilled water	100.0 g		

D-4.6 Mix cupric acetate and distilled water until dissolved and then add tergitol XD. Tergitol is a surfactant and a semisolid at normal temperature, and it is best to heat this until liquid and then add to the blend with mixing until solution clears. Reserve as blend I.

D-4.7 Mix silver acetate and distilled water until dissolved and reserve as Blend II.

Penta-check Ready to Use	*Percent by Volume*
Blend I	25
Blend II	25
Distilled water	25
*Is*opropyl alcohol (90 percent)	25
	100

D-4.8 Mix together in the order indicated in the above formulation.

D-4.9 Apply to cross-sections or borings or treated wood and observe rapid formation of red copper trichlorophenate. Excessively dark treatments tend to obscure the colour. Applications may be by brush, flow on or spray.

D-5 DETERMINATION OF PENETRATION OF SOLVENT USED WITH OIL - SOLUBLE PRESERVATIVE

D-5.1 Scope

The method is designed exclusively for determining the penetration in wood of trichlorophenol dissolved in light coloured hydrocarbon solvent type A of Standard P9. The penetration of trichlorophenol in dark-coloured hydrocarbon solvent Type A should be judged by visual examination without staining.

D-5.2 Reagents

a) 20 parts 'Speedex' filter aid powder, or calcium carbonate; and

b) 1 part oil red dyestuff powder.

Weigh dry powder and grind together with mortar and pestle.

D-5.3 Basic of Test

The dry powdered oil red dyestuff dissolves in petroleum solvent producing bright red colour.

ANNEX E

(Foreword)

REMEDIAL TREATMENT

E-1 GENERAL

E-1.1 This consists of inspecting *in-situ* the treated structure in service and retreating the lightly damaged portions to give additional service to timber structure.

E-2 TREATMENT OF REMOVABLE TIMBER

E-2.1 Generally after a period of 10-15 years any of the members which are lightly damaged and which can be easily taken out as in the case of railway sleepers are brought to a station with facilities to remove the damaged portion or to sterilize the same and retreat with preservatives, normally of the same composition as used earlier. In the case of sleepers, the damaged spike holes are plugged with treated pieces of timber after sterilization or with a cartridge of a preservative stick which can diffuse into the surrounding portion of the timber.

E-3 TREATMENT OF TIMBER WHICH CANNOT BE REMOVED

E-3.1 In the case of poles which cannot be removed, *in situ* treatment is given, after sterilizing the damaged portion with a portable goldsmith's torch, by applying a swab well soaked with the preservative and bandaged to the pole at the damaged site, if the pole has been originally treated with creosote or with a paste of the composition as given in **4.4.2**, **4.4.3** and **4.4.4** and covered with waterproof cloth or plastic if the pole has been originally treated with a fixed water soluble preservative. Sometimes digging around the pole may be necessary for making the inspection easy. Recently, electronic equipment has been developed to locate damaged portions of treated structures.

E-3.2 In case of building timbers and furniture, the attacked portion may be exposed if possible and given profuse brush coat/spray of organic solvent type wood preservative. In case of borer attack, bore holes may be flooded with organic solvent type preservatives or ammonia based preservatives.

Table 2 Recommended Practices for Preservation of Timber

(*Clause* 8.2)

Group	Service Condition of Treated Timber	Commodity	Process of Treatment	Preservative (*see also* 4)	Recommended Absorption kg/m³	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Timber in direct contact with ground or water especially in outside location	Sleepers (other than railway sleepers)	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50) b) CTC/LTC c) CCA followed by 10 percent asphalt in crude oil after drying	80 64 10	
		Poles, fence posts, bridge timber, box columns, shuttering, etc	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50) b) CTC/LTC c) CCA d) CCB/BCCA	160 128 12 16	
		Marine timbers				
		a) Timbers in contact with sea water, such as floating fenders, catamarans, piles etc	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with coal tar (60 : 40) b) CTC/LTC - fuel oil (50 : 50) c) CCA d) CCB/BCCA	320 320 24 32	First coal tar shall be melted and only then creosote shall be mixed with it (Trials were carried out with 80-120 grade coal tar only)
		b) Structures out of water but subject to tide, salt water splashes, etc	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50) b) CCA c) CCB/BCCA	160 12 16	
		Timber in cooling towers				
		a) Constructional members	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50) b) CCA c) CCB/BCCA	128 12 16	
		b) Timber in fill	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50) b) CCA c) CCB/BCCA	160 16 20	

Table 2 (*Continued*)

Group	Service Condition of Treated Timber	Commodity	Process of Treatment	Preservative (*see also* 4)	Recommended Absorption kg/m³	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Mine timbers				
		a) Tramline sleepers	Hot and cold process (if applicable), and pressure processes (preferable)	a) CTC/LTC with fuel oil (50 : 50)	160	If timbers become un-serviceable due to mechanical failure or are to be left in mine for safety reasons, minimum retention may be used
				b) CCA	12	
				c) CCB/BCCA	16	
		b) Pit props	Hot and cold process (if applicable), and pressure processes (preferable)	a) CCA	8	
				b) CCB/BCCA	12	
2	Timber not in direct contact with ground or water but exposed	Bridge timber, shingles scaffoldings, ladders, etc	Pressure processes	a) CTC/LTC with fuel oil (50 : 50)	120	
				b) CCA	8	
				c) CCB/BCCA	10	
3	Timber not in direct contact with ground or water but exposed and in addition given a coat of paint or varnish regularly	Weather boards, fence rails, exterior doors, windows, etc	Hot and cold process (if applicable), and pressure processes (preferable)	a) CCA	6.5	
				b) CCB/BCCA	8	
				c) ACA	6.5	
				d) Copper naphthenate	0.5	Calculated as copper
				e) Zinc naphthenate	0.8	Calculated as zinc
				f) Copper abietate	0.5	Calculated as copper
				g) Zinc abietate	0.8	Calculated as zinc
4	Building timber for internal use but in contact with ground, soil or under humid conditions	Doors, windows, frames, leaves, ceiling, trusses, timber columns, pole support, etc	Hot and cold process (if applicable), diffusion treatment of green timber and pressure processes	a) CTC/LTC	80	
				b) CCA	6.5	
				c) CCB/BCCA	8	
				d) ACA	6.5	
				e) Copper naphthenate/ abietate	0.5	Calculated as copper
				f) Zinc naphthenate/abietate	0.8	Calculated as zinc
				g) TCP	5	
5	Building timber or timbers in interior use not in contact with ground or soil	a) Doors and windows, leaves, false ceiling, Purlins, pelmet, etc	Hot and cold process (if applicable), diffusion treatment of green timber and pressure processes	a) CCA	4	
				b) CCB/BCCA	6.5	
				c) ACA	4	
				d) Copper naphthe-nate/ abietate	0.5	Calculated as copper

Table 2 (*Continued*)

Group	Service Condition of Treated Timber	Commodity	Process of Treatment	Preservative (*see also* 4)	Recommended Absorption kg/m³	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				e) Zinc naphthenate/abietate	0.8	Calculated as zinc
				f) Boric acid: borax	5	
				g) TCP	4	
		b) Furniture, cupboard, chicks, etc	Two liberal brush coats (solvent based) or diffusion treatment of green timber	a) TCP 4 percent + Lindane 1 percent	4	
				b) Boric acid: borax	5	
6	Timber for packing cases to be stored outside and exposed	Packing cases, pallets, ammunition boxes, cable drums, etc	Hot and cold/pressure processes	a) CCA	3.2	
				b) ACC	4	
				c) CCB/BCCA	4	
				d) ACA	3.2	
				e) Copper naphthenate/ abietate	0.5	
				f) Zinc naphthenate/abietate	0.8	
				g) TCP	4	
7	Timber for packing cases to be stored inside or under cover	do	Brushing/Spraying/Dipping	a) CCA	3.2	
				b) ACC	4	
				c) CCB/BCCA	3.2	
				d) TCP	4	
				e) ACA	3.2	
				f) Boric acid:borax	3	
				g) Copper naphthenate/abietate	0.4	Calculated as copper
				h) Zinc naphthenate/abietate	0.6	Calculated as zinc
8	Seasoned timbers and finished articles to be painted and used	Tool handles, baskets, plough, etc	Brushing/Spraying/Dipping	a) Boiling creosote	—	
				b) Copper naphthe-nate 1 percent solution	—	
				c) Zinc naphthenate 1.5 per-cent solution	—	
				d) Copper abietate 1 percent solution	—	
				e) TCP 1 percent	—	
9	Prophylactic treatment for storage of timber, etc	a) Timber logs and converted timber	Brushing/Spraying/Dipping	a) Sodium pentachlorophenate : borax (0.5 : 1.5)		

Table 2 (*Concluded*)

Group (1)	Service Condition of Treated Timber (2)	Commodity (3)	Process of Treatment (4)	Preservative (*see also* 4) (5)	Recommended Absorption kg/m³ (6)	Remarks (7)
				b) gamma BHC : NaPCP (1 : 1) 2 percent emulsion solution in water c) gamma-BHC (Lindane) 1 percent in petroleum oils d) TCP : gamma lindane (2 : 0.5) e) Chlorpyrifos/synthetic pyrethroids 1 percent emulsion		To be preferred for open storage
		b) Wood carvings, blocks for rifle butts, textile accessories, sports goods, etc Plywood logs, match logs, etc	Brushing/Spraying/Dipping	PEG (1 000) + 1 percent Na-PCP + 1 percent borax *See* IS 9104		

NOTES

1 Loading of Chemicals: In preservatives like CCA, CCB, BCCA, Chromium is only a fixative agent and does not contribute to the protection of wood. The active elements like copper, arsenic and boron in the treated timber should be in the proportion as in that of the formulation. For example, dry salt loading of 8 kg/m³ of CCA should have 4 kg of copper per cubic meter, 3 kg of chromium per cubic meter and 1 kg of arsenic per cubic meter.

Assay zone for determining retention and penetration of the preservative for :

Group 1 - In the case of timbers to be embedded in the ground like transmission poles, piles, etc. It is desirable to have at least 30 mm ring of sapwood which should be completely penetrated by the preservative; penetration in the non-durable heartwood in addition would ensure a satisfactory service life. In the case of sleepers, while it is best that the sap and durable heartwood portions is penetrated through and through (a minimum penetration of 40 mm is essential). Where the heartwood of the non-durable timbers is refractory to treatment, incision of all the surfaces except the ends to a depth of 12-19 mm is recommended to get penetration of 19 mm.

Groups 2 to 7 – Sapwood portions should be completely treated for all timbers. A minimum penetration of 12 mm in case of Groups 2 and 4; 8 mm for Group 5, for treatability class a, b and c and 4 mm for treatability class d and e and 3 mm for Groups 6 and 7 is essential.

2 Percentages in col 5 refer to strength of solution to be used for dipping, soaking, brush or spray treatment. For pressure and open tank treatments, the absorptions are indicated in col 6 and refer to the assay zone penetrated portions of the timber. Unless stated otherwise the above treatments ensure protection against fungal decay, termite and borer attack. The absorptions given under col 6 against Groups 6 and 7 shall enable repeated use of the treated material, provided suitably strong solution is used originally.

3 Wherever an individual value of recommended absorption is made, it shall be taken as minimum.

4 For water-soluble and organic solvent type preservatives, the absorptions mentioned against them refer only to dry chemicals present.

5 For treatment of packing cases coming in direct contact with foodstuff, timber for pencil slats, etc, only boric acid: borax treatment should be given.

6 Use of BCCA, ACA and CCA in packing cases should be restricted, as most of the packing cases find their way in household fuel, where arsenic fumes can be hazardous.

Table 3 Data on Natural Durability and Treatability of Timbers

(*Clauses* 8.3, B-1.2 *and* B-3.1)

Sl No.	Botanical Name	Standard Trade Name	Durability	Treatability
1.	Abies pindrow*†	Fir	III	d
2.	Abies spectabilis*	Fir	III	d
3.	Acacia catechu*	Khair	I	—
4.	Acacia nilotica*	Babul	I	b
5.	Acacia tortilis	Babul	II	c
6.	Acer cambellii*†	Maple	III	—
7.	Acrocarpus fraxinifolius*†	Mundani	III	c
8.	Adina cordifolia*†	Haldu	III	a
9.	Aegle marmelos*	Bael	III	—
10.	Ailanthus integrifolia (Syn. A.)	Gokul	III	—
11.	Albizia lebbeck*†‡	Kokko	I	e
12.	Albizia odoratissima*†‡	Kala-Siris	I	e
13.	Albizia procera†	Safed-Siris	I	c
14.	Albizia chinensis*	Siris	III	e
15.	Alstonia scholaris*†	Chatian	III	—
16.	Altingia excelsa*	Jutili	II	e
17.	Amoora wallichii*†	Amari	II	d
18.	Anogeissus latifolia*†‡	Axlewood (Bakli)	I	e
19.	Anogeissus pendula*‡	Kardhai	III	—
20.	Anthocephalus Chinensis*† (Syn. A. cadamba)	Kadam	III	a
21.	Aphanamixis polystachya*†‡ (Syn.amoora rohituka)	Pitraj	I	—
22.	Artocarpus chaplasha*†	Chaplash	II	d
23.	Artocarpus heterophyllus (Syn. A. integrifolia)*‡	Kathal	I	d
24.	Artocarpus hirsutus*†‡	Aini	I	—
25.	Artocarpus lakoocha*	Lakooch	I	e
26.	Barringtonia acutamgula	Hijel	III	—
27.	Bischofia javanica*†	Uriam	III	—
28.	Bombax ceiba*† (Syn. Salmalia malabarica)	Semul	III	a
29.	Boswellia serrata†	Salai	I	e
30.	Bridelia retusa†	Kassi	I	e
31.	Bruguiera spp.*	Bruguiera	III	—
32.	Butea monosperma* (Syn. B. frondosa)	Palas	III	—
33.	Calophyllum apetalum* (Syn. C. wightinum)	Poon	III	e
34.	Calophyllum elatun* (Syn. C. tomentosum)	Poon	II	—
35.	Canarium euphyllum*	White dhup	III	—

Table 3 (*Continued*)

Sl No.	Botanical Name	Standard Trade Name	Durability	Treatability
36.	Canarium strictum*	white dhup	III	—
37.	Careya arborea*	Kumbi	I	e
38.	Cassia fistula*	Amaltas	I	—
39.	Castanopsis hystrix*†	Indian chestnut	II	b
40.	Casuarina equisetifolia*	Casuarina	III	e
41.	Cedrus deodara*	Deodar	I	c
42.	Chloroxylon swietenia*	Satinwood	III	—
43.	Chukrasia velutina† (Syn. C. tabularis)	Chickrassy	II	c
44.	Cinnamomum cecidodaphne*	Cinnamon	III	e
45.	Cinnamomum zeylanicum†	Cinnamon	III	—
46.	Cleistanthus collinus*†	Karada	II	—
47.	Cryptomeria japonica*	Suji (Dhupi)	III	e
48.	Cullenia rosayroana*† (Syn. C.excelsa)	Karani	III	b
49.	Cupressus torulosa†*	Cypress	I	e
50.	Dalbergia latifolia*†	Rosewood	I	—
51.	Dalbergia sissoo*†	Sissoo	I	e
52.	Dichopsis polyanthe	Pali	I	—
53.	Dillenia indica*†	Dillenia	III	a
54.	Dillenia pentagyna*	Dillenia	III	d
55.	Diospyros ebenum*†	Ebony	II	—
56.	Diospyros malanoxylon*†	Ebony	II	—
57.	Diospyros pyrrhocarpa†	Ebony	III	—
58.	Dipterocarpus grandiflorus† (Syn. D. Driffithii)	Gurjan	I	—
59.	Dipterocarpus indicanus‡†	Gurjan	II	—
60.	Dipterocarpus indicus*†	Gurjan	II	b
61.	Dipterocarpus kerrii*	Gurjan	III	—
62.	Dipterocarpus macrocarpus*	Hollong	III	a
63.	Dipterocarpus turbinatus†	Gurjan	II	b
64.	Duabanga grandiflora*† (Syn. D. sonneratioides)	Lampati	III	c
65.	Dysoxylum malabaricum*†‡	White Cedar	I	—
66.	Eriolaena candollei*	Salmonwood	I	—
67.	Eucalyptus camaldulensis	Eucalyptus	I	e
68.	Eucalyptus globulus*†	Blue gum	I	e
69.	Eucalyptus hybrid	Eucalyptus	II	e
70.	Eucalyptus rostrata	Eucalyptus	II	—
71.	Eucalyptus tereticornis	Mysore Gum	III	e
72.	Exbucklandia spp.	Pipli	III	e

Table 3 (*Continued*)

Sl No.	Botanical Name	Standard Trade Name	Durability	Treatability
73.	Ficus bengalensis†	Fig	III	—
74.	Fraxinus excelsior*	Ash	III	—
75.	Fraxinus floribunda*	Ash	III	—
76.	Garuga pinnata†	Garuga	I	e
77.	Gluta travancorica*	Gluta	I	—
78.	Gmelina arborea*†	Gamari	I	e
79.	Grevillea robusta*†	Silver Oak	III	—
80.	Grewia tiliifolia*†	Dhaman	III	d
81.	Hardwickia binata*‡	Anjan	I	e
82.	Heritiera minor†*‡ (Syn. H. fomes)	Sundri	I	—
83.	Hevea braziliensis	Rubberwood	III	a
84.	Holoptelea integrifolia*	Kanju	III	b
85.	Hopea cordifolia*	Hopea	I	e
86.	Hopea glabra*‡	Hopea	I	—
87.	Hopea parviflora*	Hopea	I	e
88.	Hymenodictyon excelsum*†	Kuthan	III	e
89.	Juglans falla*†	Walnut	III	—
90.	Juglans regia*†	Walnut	III	—
91.	Knema attenuata*† (Syn. Myristica attenuata)	Jathikai	III	—
92.	Kydia calycina	Pula	III	—
93.	Lagerstroemia hypoleuca*	Pyinma	I	—
94.	Lagerstroemia lanceolata*†	Benteak	I	e
95.	Lagerstroemia parviflora*	Lendi	I	e
96.	Lagerstroemia speciosa*† (Syn. L. flosreginae)	Jarul	II	e
97.	Lophopetalum wightianum*	Banati	III	—
98.	Machilus gamblei*	Machilus	III	e
99.	Machilus macrantha†	Machilus	III	e
100.	Madhuca longifolia* (Syn.Bassia latifolia)	Mahuala	I	e
101.	Mallotus philippensis*	Raini	III	—
102.	Mangifera indica.*†	Mango	III	a
103.	Maniltoa polyandra*† (Syn. Cynometra polyandra)	Ping	III	b
104.	Melia azedarach*† (Bakain)	Persian lilac	III	c
105.	Mesua assamica†	Sianahor	II	e
106.	Mesua ferrea*†‡	Mesua	I	—
107.	Mesua floribunda*	Mesua	III	—
108.	Michelia doltsopa*† (Syn. M. excelsa)	Champ	II	e
109.	Michelia montana*	Champ	I	—

Table 3 (*Continued*)

Sl No.	Botanical Name	Standard Trade Name	Durability	Treatability
110.	Miliusa tomentosa* (Syn.Saccopetalum tomentosum)	Hoom	III	—
111.	Miliusa velutina	—	III	—
112.	Mimusops elengi*‡	Bakul	I	—
113.	Mitragyna parvifolia*† (Syn.Stephegyna parvifolia)	Kaim	III	b
114.	Morus alba†	Mulberry	II	—
115.	Morus serrata*	Mulberry	III	—
116.	Orina wodier (syn. Lannea coromandelica)	Jhingan	I	e
117.	Ougeinia cojeinensis*†‡ (Syn.O.dalbergioides)	Sandan	I	—
118.	Pajanelia longifolia† (Syn. P. rheedii) (Andaman Jhingan)	Pajanelia	III	—
119.	Palaquium ellipticum*‡ (Syn. Dichopsis elliptica)	Pali	II	e
120.	Parishia insignis*	Red dhup	III	—
121.	Parrotiopsis jacquemontiana* (Syn.Parrotia jacquemontiana)	Pohu (Parrotia)	III	—
122.	Paulownia spp.	—	—	b
123.	Phoebe hainesiana*	Bonsum	II	c
124.	Phyllanthus emblica	—	III	—
125.	Picea smithiana*† (Syn. P. morinda)	Spruce	III	d
126.	Pinus kesiya	Khasi pine	III	a
127.	Pinus roxburghii*† (Syn. P.longifolia)	Chir	III	b
128.	Pinus wallichiana† (Syn.P.excelsa)	Kail	II	c
129.	Planchonia valida* (Syn.P. Andamanica)	Red bombwe	III	—
130.	Podocarpus neriifolia*	Thitmin	II	—
131.	Poeciloneuron indicum†	Ballagi	I	e
132.	Polyalthia fragrans* (Nedunar)	Debdaru	III	—
133.	Polyanthus amblica	—	III	—
134.	Populus spp.	Poplar	III	a
135.	Protium serratum* (Syn.Bursera serrata)	Murtenga	II	e
136.	Pterocarpus dalbergioides*†	Padauk	I	c
137.	Pterocarpus marsupium*†‡	Bijasal	I	e
138.	Pterocymbium tinctorium* (Syn. S. campanulata)	Papita	III	—
139.	Pterospermum acerifolium*	Hathipaila	III	c
140.	Pterygota alata† (Syn. Sterculia alata)	Narikel	III	—
141.	Quercus lamellose*†	Indian Oak	II	c
142.	Quercus lineata*	Indian Oak	II	c
143.	Radermachera xylocarpa* (Syn. Stereospermum Xylocarpum)	—	II	a
144.	Schima wallichii*	Chilauni	III	d

Table 3 (*Continued*)

Sl No.	Botanical Name	Standard Trade Name	Durability	Treatability
145.	Schleichera oleosa† (Syn. S.trijuga)	Kusum	II	a
146.	Shorea assamica*	Makai	III	c
147.	Shorea robusta*†‡	Sal	I	e
148.	Sonnertia apetala†	Keora	II	—
149.	Soymida febrifuga*‡	Rohini	I	—
150.	Spondias pinnata† (Syn. S. mangifera)	Amra	III	—
151.	Stereospermum colais* (Syn. chelonoides)	Padri	III	—
152.	Stereospermum chelonoides* (Syn. Suaveolens)	Padri	III	—
153.	Stereospermun xylocarpum	Kharsing	I	a
154.	Syzygium gardneri* (Syn. Eugenia gardneri)	Jaman	III	d
155.	Syzygium praerox* (Syn. Eugenia praecox)	Jaman	III	—
156.	Syzygium cumini† (Syn. Eugenia jambolana)	Jaman	II	e
157.	Tectona grandis*†‡	Teak	I	e
158.	Terminalia alata*†‡	Laural	I	b
159.	Terminalia arjuna*†	Arjun	II	b
160.	Terminalia bellirica*†	Bahera	III	b
161.	Terminalia bialata*†	White Chuglam	III	e
162.	Terminalia chebula†	Myrobalan	II	c
163.	Terminalia manii*	Black Chuglam	II	a
164.	Terminalia myriocarpa*†	Hollock	III	a
165.	Terminalia paniculata†‡	Kindal	I	c
166.	Terminalia procera*†	White Bombwe	III	b
167.	Toona ciliata*†	Toon	II	c
168.	Trevia nudiflora†	Gutel	III	—
169.	Ulmus wallichiana*	Elm	III	—
170.	Vateria indica*†	Vellapine	III	e
171.	Vitex altissima*†‡	Milla	I	e
172.	Xylia xylocarpa*†‡	Irul	I	e
173.	Zanthoxylum rhetsa*† (Syn.Fagara budrunga Z. budrunga Z. limonelia)	Mullilam	I	e

Legend I - Average life more than 120 months.

Legend II - Average life 60 months and above but less than 12 months.

Legend III - Average life less than 60 months.

* Durability test carried on sample size 5 x 5 x 50 cm.

† Durability test carried on sample size 3.8 x 3.8 x 30.5 cm.

‡ Some of the specimens are not yet rejected and are undergoing test in the yard. Their average life here is calculated on the results obtained upto date.

¶ Some of the specimens are found missing. The average life is, therefore calculated upto their missing date.

ANNEX F

(Foreword)

COMMITTEE COMPOSITION

Timber and Timber Stores Sectional Committee, CED 9

Organization	*Representative(s)*
In Personal Capacity *(2989/D 12th Main, HAL II Stage, Bangalore 560008)*	SHRI SHYAM SUNDER (***Chairman***)
Andaman Chambers of Commerce and Industries, Kolkata	SHRI S. KUMAR SHRI S. C. MALHOTRA (*Alternate*)
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Directorate General of Civil Aviation, New Delhi	SHRI N. M. WALECHA SHRI ANAND PRAKASH (*Alternate*)
Directorate of Naval Architecture, New Delhi	DEPUTY DIRECTOR OF NAVAL ARCHITETURE ASSISTANT DIRECTOR OF NAVAL ARCHITECTURE (*Alternate*)
Directorate General of Supplies and Disposal, New Delhi	SHRI D. B. JAIN SHRI DARBARA SINGH (*Alternate*)
Directorate General of Ordnance Factories, Gun Carriage Factory, Jabalpur	SHRI M. R. GHAI
Directorate General of Border Roads, New Delhi	LT-COL M. V. RANGAIAH
Engineer-in-Chief's Branch, Army Headquarters, New Delhi	SHRI B. B. SHAMBARKAR SHRI A. K. AGARWAL (*Alternate*)
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Forest Department, Government of Uttar Pradesh, Nainital	CHIEF CONSERVATOR OF FORESTS (Mgt) ADDITIONAL CHIEF CONSERVATOR OF FORESTS (*Alternate*)
Forest Department, Andaman and Nicobar Islands, Port Blair	SHRI B. A. MATHEWS SHRI SHIVAPRAKASH (*Alternate*)
Forest Department, Government of Arunachal Pradesh, Itanagar	REPRESENTATIVE
Forest Department, Government of Himachal Pradesh, Simla	CHIEF CONSERVATOR OF FORESTS CONSERVATOR OF FORESTS (*Alternate*)
Forest Department, Government of Karnataka, Bangalore	CHIEF CONSERVATOR OF FORESTS
Forest Department, Government of Madhya Pradesh, Bhopal	SHRI G. P. BADOLA SHRI ATUL KHERA (*Alternate*)
Forest Department, Government of Mizoram, Aizawl	REPRESENTATIVE
Forest Research Institute, Dehra Dun	DIRECTOR SHRI K. S. SHUKLA (*Alternate*)
Indian Plywood Industries Research and Training Institute, Bangalore	SHRI A. K. BANSAL SHRI K. DAMODARAN (*Alternate*)

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Organization	*Representative(s)*
Indian Plywood Manufacturing Co Ltd, Mumbai	SHRI P. T. S. MENON
Indian Tea Association, Kolkata	SHRI S. GHOSH SHRI M. DASGUPTA (*Alternate*)
Indian Tobacco Company, Secunderabad	REPRESENTATIVE
Institute of Wood Science and Technology, Bangalore	SHRI A. K. ANANTHANARAYANA SHRIMATI B. S. KAMALA (*Alternate*)
Kerala Forest Research Institute, Peechi	DR R. GNANAHARAN
Kutty Flush Doors and Co Pvt Ltd, Chennai	SHRI K. SANKARAKRISHNAN SHRI D. R. ANANTHAKRISHANANA (*Alternate*)
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Ministry of Defence (DRDO), Kanpur	SHRI ANIL AGARWAL SHRI H. C. PANT (*Alternate*)
Ministry of Environment and Forest, New Delhi	INSPECTOR GENERAL OF FORESTS ADDITIONAL INSPECTOR GENERAL OF FORESTS (*Alternate*)
National Test House (ER), Kolkata	SHRI D. K. KANUNGO SHRI B. K. MANDAL (*Alternate*)
Railway Board, New Delhi	DIRECTOR (TRACK) JOINT DIRECTOR CE (TM) (*Alternate*)
Tea Board, Kolkata	DR T. C. CHOUDHARY
The Karnataka State Forest Industries Corporation Ltd, Bangalore	SHRI ERAPPA SHRI S. K. CHAKRABORTY (*Alternate*)
WIMCO Limited, New Delhi	SHRI S. SUBRAMONI SHRI S. S. AKBAR (*Alternate*)
In Personal Capacity *(C-59, Inder Puri, New Delhi- 110012)*	DR A. N. NAYER
In Personal Capacity, *(Pratap Nursery Lane, Panditwari, Dehra Dun)*	SHRI K. S. PRUTHI
In Personal Capacity *(214, Phase-1, Vasant Vihar Dehra Dun 248006)*	DR SATISH KUMAR
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Member-Secretary
SHRIMATI RACHNA SEHGAL
Deputy Director (Civ Engg), BIS

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Timber Treatment Subcommittee, CED 9 : 12

Organization	*Representative(s)*
Kerala Forest Research Institute, Peechi	DR R. GNANAHARAN (***Convener***)
Andaman Timber Industries, Port Blair	REPRESENTATIVE
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Indian Plywood Industries Research and Training Institute, Bangalore	SHRI S. PADMANABHAN SHRIMATI S. Z. M. KAMAL (*Alternate*)
Indian Rubber Wood Task Force, Kottayam	SHRI C. BHASKARE NAIR SHRI V. J. MATHEWS (*Alternate*)
Indian Wood Science and Technology, Bangalore	REPRESENTATIVE
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In Personal Capacity *(214, Phase-1, Vasant Vihar Dehra Dun 248006)*	DR SATISH KUMAR

(*Continued from second cover*)

Generally, application of grease on the hands, feet and face and use of gloves and gas masks is suggested. Treated and dried timber, however, does not pose any risk in handling or during use, as most of the formulations recommended become a part of the wood.

The preservatives recommended are mostly based on their performance under local conditions. Also, this standard is intended as a technical guide and it is absolutely necessary to entrust treatment to a well qualified and experienced technician, who has also laboratory and field equipment to identify and evaluate the preservatives in respect of their purity, correctness of the composition and their presence in the treated material quantitatively. The treated structure should be under careful periodic observation and if any damage is noticed, remedial (*see* Annex E) treatment should be immediately imparted to obtain the expected economic service.

The Bureau of Indian Standards calls attention to the fact that it is claimed that some of the compositions are owned by some companies. Although these patents cover the subject of this standard, the Bureau of Indian Standards takes no position with regard to their individual validities. Interested parties are advised to contact the patent holders of the above products in their own interest as and when necessary.

In the preparation of this code, considerable assistance has been rendered by the Research Institutes through supply of important data and information with regard to preservatives and their performance under Indian conditions.

The Sectional Committee responsible for the preparation of this standard has taken into consideration the views of producers, consumers and technologists and has related the standard to the manufacturing and trade practices followed in the country in this field. Due weightage has also been given to the need for international co-ordination among standards prevailing in different countries of the world in this field.

This standard is intended chiefly to cover the technical provisions relating to preservation of timber, and it does not include all the necessary provisions of a contract.

The composition of the Committee responsible for the preparation of this standard is given in Annex F.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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This Indian Standard has been developed from Doc : No. CED 9 (5763).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at New India Printing Press, Khurja, India